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**REVISION OF THE SPECIES OF
THE SAYI-GROUP OF
CHLOROCHROA STAL
(HEMIPTERA: PENTATOMIDAE)**

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**REVISION OF THE SPECIES OF
THE SAYI-GROUP OF
CHLOROCHROA STAL
(HEMIPTERA: PENTATOMIDAE)**

by

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The name *Chlorochroa* Stal is here used for a group of species of large green stink bugs, some of which have long been known as important pests of cultivated crops.

The present ranking as a full genus following Van Duzee (1916) is done for convenience and for clarity of communication with economic entomologists. It is recognized that the group is one of several closely related genera of the Pentatomini whose taxonomic status is still not firmly established in a generally accepted manner. Kirkaldy (1909) considered these groups to comprise subgenera of the genus *Rhytidilomia* Stal. Van Duzee (1916) considered each—*Chlorochroa* Stal, *Liodermin* Kirkaldy, *Pitedia* Reuter, and *Rhytidilomia* Stal—as separate genera. Hart (1919) and Torre-Bueno (1939) recognized *Chlorochroa* and *Rhytidilomia* as full genera with *Liodermin* subsumed under the latter. The species of *Pitedia* are palearctic.

Chlorochroa contains two species groups separable on length of beak. In the Sayi-group (treated here), the beak reaches or barely surpasses the hind coxae; in the Opuntiae-group, it greatly surpasses the hind coxae.

The Sayi-group is readily and precisely defined by the following characteristics:

1. Labium reaching or barely surpassing hind coxae.
2. Labial segment II longest, subequal to III and IV combined.
3. Pygophore with two spines projecting into its basin.
4. Pygophore with partial or well developed subapical transverse ridge.
5. Pronotal margins reflexed.

The Sayi-group includes *Chlorochroa ligata* (Say) (the type species selected by Kirkaldy 1909:53), *C. sayi* (Stal), *C. uhleri* (Stal), *C. persimilis* Horvath, *C. granulosa* (Uhler), *Cimex flavomarginatus* Kouchakevitch (preoccupied and here given the new name *Chlorochroa rossiana*), *C. congrua* Uhler, and two new species, *C. kanei* and *C. norlandorum*.

The *Chlorochroa* species treated in this paper comprise a natural grouping of stink bugs, which, with the exception of *C. persimilis* is confined to the western half of the North American continent and is found in greater numbers between 30° and 50° North latitude. *C. persimilis* is found in the eastern half of the continent from Florida to the upper portion of Quebec.

Species limits within this group have always been poorly defined, partly because the characters employed were too variable and partly because the importance of critical characters were not recognized.

Sailer (1954) experienced difficulty in identifying *Chlorochroa* populations in Oregon, Washington, British Columbia, Montana, Idaho, Utah, and eastern Washington and Oregon. He was undecided as to whether the forms were species, subspecies, local populations, or hybrids. In the northwest, problems were probably caused by *Chlorochroa rossiana* (*Cimex flavomarginatus*). Some specimens of *Chlorochroa ligata* in that area have no purple flecking in the wing membrane. In the intermountain area, problems were probably caused by *Chlorochroa granulosa*. We encountered a problem similar to Dr. Sailer's while studying far western specimens of *C. persimilis* and far eastern specimens of *C. granulosa*. One must pay close attention to all key characters when identifying specimens from this area.

ACKNOWLEDGMENTS

The authors wish to express their gratitude to the many people who contributed their assistance to the completion of this study. Several persons communicated valuable information that greatly facilitated certain aspects of this work; in particular Dr. I. M. Kerzhner of the Leningrad Museum for lending Kouchakevitch types, translating Russian, pointing out homonymy of *Cimex flavomarginatus* and other nomenclatorial problems; and Dr. I. Lansbury of Oxford University for clarifying the identity of *Pentatoma harrisi* Westwood. Additionally, Dr. Per Inge Persson of the Rijksmuseum, Stockholm, kindly provided us with Stal's types, and Dr. M. T. James of Washington State University provided paratypes of *Chlorochroa opuntiae* Esselbaugh.

We also wish to thank the several persons that provided us with bionomic information, notably Mr. C. Norland, San Diego State University; the late E. A. Kane of the California Department of Food and Agriculture; Dr. George F. Knowlton, Utah State University; and Dr. R. I. Sailer, University of Florida. In addition, Dr. L. H. Rolston of Louisiana State University brought to our attention the homonymy of *Cimex flavomarginatus* Kouch.

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MATERIALS AND METHODS

Over 5,000 specimens of *Chlorochroa* were examined during this study. The majority of these were borrowed from the museum collections which are cited in the acknowledgments.

The type specimens of *Chlorochroa sayi*, *C. uhleri*, *C. granulosa*, and *C. congrua* and paratypes of *C. opuntiae* were examined. Dr. I. M. Kerzhner of the Leningrad Zoological Institute kindly provided us with homotypes of *Cimex flavomarginatus* and *Cimex rubromarginatus*. We were unable to locate Kouchakevitch's type of *Cimex albosparsus* at the known depositories of the Osten-Sacken collections (East Berlin; American Museum of Natural History, New York; Museum of Comparative Zoology, Harvard University), and thus we were unable to fix the identity of this species; since the original description is inadequate, we must consider this form a *nomen dubium* until some of the types are found.

Characters diagnostic for both sexes in this genus include length of the rostrum and proportions of its segments; the width of the embolium; presence or absence of purple flecks on the hemelytral membrane. In male specimens, the shape and development of a subapical transverse ridge on the pygophoral venter and configuration of the tridactylate parameres are of specific value.

Characters of specific identification value in the females other than embolar width and membranal flecking are difficult to find; however, geographical locality and male association will often be helpful in making identifications.

KEY TO THE MALES OF THE CHLOROCHROA SAYI-GROUP

- 1a. Embolium subparallel or a little widened apically, i.e., the apex less than twice the width of the base (Figures 3 and 4); male paramere with the angle between the posterior and median process more than 90°; base of scutellum with three pale callosities (Western half of United States) 2
- 1b. Embolium distinctly widened apically, i.e., the apex more than twice the width of the base (Figures 5-11); male paramere with the angle between the posterior and median process about 90°; callosities at the base of the scutellum lacking or very small .. 3
- 2a. Embolium parallel, not widened apically; callosities at base of scutellum large, distinct; membrane of hemelytra with purple flecks (Figure 3) *sayi*
- 2b. Embolium wider apically; callosities at base of scutellum moderate to small; membrane of hemelytra without purple flecks (Figure 4) *uhleri*
- 3a. Male pygophore with transverse subapical ridge reduced to a central tumescence subtended laterally by a pair of smaller tumescences on each side *ligata*
- 3b. Male pygophore with a well developed transverse subapical ridge on the median ventral surface 4
- 4a. Anterolateral pronotal margins strongly reflected 5
- 4b. Anterolateral pronotal margins carinate and only feebly reflexed; mesosternum sometimes with a pair of black spots either side of the median. Confined to coasts below Los Angeles into Mexico *norlandorum*
- 5a. Pygophoral subapical transverse ridge labiate in form, the margin tumid. West coasts of United States and South Canada *rossiana*
- 5b. Pygophoral subapical transverse ridge arcuate in form, the margin carinate 6
- 6a. Size small; 11 mm. or less; processes of male paramere short, especially its median process. Rocky Mountain states, usually above 9,000 feet (Figure 17)..... *congrua*
- 6b. Size large, more than 11 mm.; processes of male parameres more elongate 7

- 7a. Corium with pale, blister-like flecks, or if these lacking, then tip of scutellum without white tip. Rocky Mountain states, usually below 9,000 feet *granulosa*
- 7b. Corium clear green and usually with a distinct white spot at tip of scutellum 8
- 8a. Posterior process of male paramere terete and distinctly hooked forward. Eastern United States (Figure 19) *persimilis*
- 8b. Posterior process of male paramere not as above, usually capitate. Sierra Nevadas (Figure 16) *kanei*

***CHLOROCHROA SAYI* (STAL)**

(Figures 1, 3, 12, 21)

Lioderma (Chlorochroa) sayi Stal, 1872: 33.

Pentatoma (Chlorochroa) sayi: Van Duzee, 1904: 41–42.

Rhytidolomia (Chlorochroa) sayi: Kirkaldy, 1909: 53.

Chlorochroa sayi: Van Duzee, 1916: 5.

Ptedia sayi: Slater and Baranowski, 1978: 51.

Elongate, oval; width greatest through the humeri; moderately convex above and below. Color usually green flecked with white dorsally, paler ventrally; anterolateral thoracic margins, base of costa, connexivum and apex of scutellum yellowish to orange; tergum concolorously black to dark fuscous except last segment mottled with green. Three large, white or cream laevigate callosities at the base of the scutellum, one in each angle and one medially. Puncturation dorsally dense, distinct, concolorous; ventrally finer. Head slightly longer than width across the eyes; jugae and tylus subequal; antennal segment I shortest, green; II the longest, fuscous to black; III, IV, and V subequal, fuscous to black. Rostrum in repose just attaining base of abdomen; segment II as long as last two segments combined; last two segments subequal. Embolium narrow, of equal width basally and apically. Pronotum, scutellum and especially corium with numerous, small, pale, rugulose callosities. Membrane of hemelytra with numerous, small purple flecks. Male pygophore with a well developed, bulbous, subapical transverse ridge; the apex arcuate, feebly margined and shallowly excavated. Paramere tridactylate; the form elongate, narrow; the two anterior processes joined to apical third, apex divided, short, proximate; posterior process narrow, styliform, angle between this and anterior processes distinctly greater than 90°. Length: 10–16 mm.

Stal's female specimen bears six labels: one with the printed abbreviation "Cala."; one written in ink "California, Uhler"; one red label printed and outlined "Typus"; one green label printed "Riksmuseum Stockholm"; one label printed "Type"; and a square label with the numbers 11 over 69 (Riksmuseum, Stockholm).

The structure of the terminalia is essentially identical to that of *C. uhleri* and confirms Stal's conclusion that the two species are closely

related. *C. sayi* can be differentiated by the parallel embolium and the purple flecked membrane. Additionally, the body form is narrower, the callosities at the base of the scutellum are larger and more distinct, and the tergum is darker. This is known as the "grain bug" or "Say stink bug" of economic literature (Caffrey and Barber, 1919). It is found within the range of all species of *Chlorochroa* except *C. persimilis*, and is the least plastic of all species studied.

One night in the summer of 1973 in Nevada, the second author saw thousands of specimens of this species at the city lights in Las Vegas and around the lights of an isolated service station 50 miles away. At both places, the air was permeated by the bugs' "scent."

This insect has been captured on a wide array of plants. These are commonly woody or herbaceous shrubs, such as Russian thistle (*Salsola iberica*), Tumblemustard (*Sisymbrium altissimum*), Saltbush (*Atriplex* spp.), Mormon tea (*Ephedra* spp.), Hopsage (*Grayia spinosa*), and sage (*Artemisia* spp.).

Other food plants are reported by Caffrey and Barber (1919) and include wheat, barley, rye, and alfalfa.

***CHLOROCHROA UHLERI* (STAL)**

(Figures 4, 13, 22)

Lioderma (*Chlorochroa*) *uhleri* Stal, 1872: 33.

Pentatoma (*Chlorochroa*) *uhleri*: Van Duzee, 1904: 39.

Rhytidolomia (*Chlorochroa*) *uhleri*: Kirkaldy, 1909: 53.

Chlorochroa uhleri: Van Duzee, 1916: 5.

Ovate, slightly convex above, moderately convex below; dorsum and pleura densely punctate, the abdominal venter more finely punctate. Color pale green above; paler, yellower ventrally. Head slightly longer than width across the eyes; tylus and jugae subequal, the latter feebly acuminate; antennal segment I the shortest, II distinctly the longest, last three subequal and darker; rostrum in repose just surpassing the metacoxae, segments II and IV subequal, segment II as long as last two combined. Embolium narrow, slightly wider apically than at base; thorax, corium and scutellum with numerous, pale, rugulose callosities; three distinct callouses at the base of the scutellum, one at each angle and one medially; apex of scutellum pale, laevigate. Abdominal dorsum black or infuscated anteriorly, last tergite(s) greenish. Anterolateral thoracic margins, base of costa and convexium smooth, pale yellow. Hemelytral membrane hyaline, without flecking. Male pygophore with a well developed, bulbous, truncated prominence; paramere tridactylate, the form elongated, narrow, the two anterior processes joined to apical third, apex divided, short, proximate; the posterior process narrow styliform, distinctly angled more than 90° from the anterior processes. Length: 12–16 mm.

There is no evidence that Stal ever chose holotypes or a single "type" out of a series. The various "type" labels referred to below were added later. The female specimen bears seven labels: one printed "Type"; one

printed "Mexico"; one printed "Salle"; one green label printed "Riksmuseum Stockholm"; one red label printed "Type"; one red label printed and outlined "Typus"; and a square label with the numbers 12 over 69. The wings and hemelytra are spread and the callosities are obsolescent. The specimen has some dermestid damage.

The male specimen bears seven labels: one printed "Type"; one printed "Mexico"; one written in ink "Boucard"; one red label printed and outlined "Allotypus"; one green label printed "Riksmuseum Stockholm"; one red label printed "Type"; and a square label with the number 13 over 69. The left wing protrudes from the specimen, and the last two antennal segments are missing. The genitalic structure is typical.

The structure of the male terminalia is essentially identical to that of *C. sayi*. From this species it can be differentiated by the apically wider embolium as compared to the base, and the hyaline, unspotted, hemelytral membrane. Additionally, the body is broader, less convex; the callosities at the base of the scutellum are smaller and the abdominal dorsum is bicolorous. The range of *C. uhleri* appears to overlap the range of *C. sayi* and although very close morphologically we have seen no specimens having nonparallel embolium with purple flecks nor specimens having a parallel embolium without the flecks. Some of the damage ascribed to *C. sayi* may very well have been caused by *C. uhleri*.

In September 1972 this species was found in great numbers apparently attracted to lights at the City of Niland, Imperial County, California. Their distinctive odor permeated the air.

This species has been taken from a wide array of plants of which the most common are: Russian thistle (*Salsola iberica*), Tansymustard (*Descurainia pinnata*), Alfalfa (*Medicago sativa*), Wheat (*Triticum aestivum*), and Tumblemustard (*Sisymbrium altissimum*).

***CHLOROCHROA LIGATA* (SAY)**

(Figures 2, 5, 14, 23)

Pentatoma ligata Say, 1832: 5.

Lioderma (Chlorochroa) ligata Stal, 1872: 33.

Rhytidilomia (Chlorochroa) ligata: Kirkaldy, 1909: 53.

Chlorochroa ligata: Van Duzee, 1916: 5.

Cimex rufocinctus Herrich-Schaeffer, 1839: 33.

Cimex rubromarginatus Kouchakevitch, 1867: 99.

Pentatoma marginalis Walker, 1868: 288.

Pitedia ligata: Slater and Baranowski, 1978: 51.

Body ovate, somewhat flattened or only feebly convex above, distinctly convex below; densely, evenly punctate above and on the thoracic pleura below, abdominal puncturation sparser. Color olive-green, grey, or black; anterolateral thoracic margin, the costa basally, connexivum and apex of scutellum pale orange to red. Head a little longer than width across the eyes; dorsally planate; edge sinuate, emarginate; jugae slightly surpassing tylus and feebly acuminate; antenna blackish except the base green; segment I shortest, II longest, last three subequal or with III sometimes slightly shorter; rostrum

attains posterior edge of metasternum in repose, segment II as long as last two segments combined, segments III and IV subequal. Pronotum broad, somewhat tumid near the humeral angles; surface feebly rugulose; anterolateral margin almost straight, reflexed. Scutellum broad; apex and small areas near the basal angles impunctate. Embolium at apex more than twice as wide as base; hemelytral membrane with minute purple flecks, rarely hyaline. Tergum unicolorous black or last segment mottled. Ventral surface of male pygophore tumidly produced, a feeble vestige of an amargination and not the well developed subapical transverse ridge found in other species; reduced to two lateral and one slightly larger median tumescence with shallow concavities between. The parameres tridactylate, the lateral processes at a 90° angle; anterior process styloform, angulate apically; posterior process short, unilaterally tumid at the apex; median process an obtusely acuminate flange, anteriorly produced. Length: 13–19 mm.

Types lost. Described by Say from the "Missouri Territory" which prior to 1832 included much of the midwest.

Averages larger and darker than other *Chlorochroa*; dorsally broader and flatter. Male pygophore is diagnostic with submarginal prominence vestigial. Northern specimens tend to be smaller and greener than southern *C. ligata*.

The only area to date in which we have seen *C. ligata* without purple membranous flecks is in some of the specimens from Oregon and Washington. The paper by Fish and Alcock (1973), refers to the hyaline wing variety. This species possibly has the widest range of all species studied and is the "conchuela" of economic literature (Morrill, 1905–1907). A third instar nymph from Fairbanks, Alaska, may have been this species. *C. ligata* has been recorded as far east as Arkansas and Kansas.

In the southwest this species is common on mesquite (*Prosopis juliflora*) and Utah juniper (*Juniperus osteosperma*). Fish and Alcock, 1973, stated they were found in abundance on blackberries (*Rubus laciniatus*) in the State of Washington. It has also been collected from strawberries (*Fragaria spp.*).

**CHLOROCHROA NORLANDORUM BUXTON AND
THOMAS, N. SP.**
(Figures 6, 15, 24)

Ovate; feebly convex above, moderately convex below. Deeply confluent punctate dorsally, punctures shallower and sparser ventrally. Color pale, sordid stramineous or greenish; corium with small pale rugulose callosities, sometimes feeble or lacking; tergum piceous except last segment and the posterior margin of penultimate segment greenish with black; either side of mesosternal carina with a broad, piceous spot; usually a fuscous vitta on each sternite between the spiracle and the trichobothria. Head a little longer than width between the eyes; jugae feebly acuminate and slightly surpassing or subequaling the tylus; antennal segment I the shortest, II the longest, IV and V subequal, III a little shorter; rostrum moderately long, reaching middle

of sternite abdominal III (2nd visible); segment II as long as III and IV combined, III slightly longer than IV. Anterolateral thoracic margin weakly to moderately reflexed; concavely arcuate. Embolium widened apically three times the basal width. Hemelytral membrane hyaline. Male pygophore with well developed, bulbous, subapical transverse ridge; arcuate in aspect; shallowly excavated, the margin setose. Paramere tridactylate; lateral processes at a 90° angle; anterior process long, fusiform, frequently with an angulate cusp on its inner side; median process obtusely acuminate and strongly produced anteriorly; posterior process short, stout, sometimes curving forward.

Holotype: Male, California, San Diego County, Silver Strand State Park, G. M. Buxton, Collector, April 7, 1971. Deposited U.S.N.M. #76128.

Paratypes: 1 male, same data as holotype. 22 males and 24 females, same locality and collector as holotype, March 25, 1971. Deposited U.S.N.M. California Academy of Science, Los Angeles County Museum, University of Missouri, Am. Museum of Natural History, and collection of authors.

Twelve additional paratypes were examined from California: *San Diego County*: San Diego, Imperial Beach; Silver Strand. *Mexico*: *Sinaloa*: Mazatlan. *Sonora*: Huatabampito. *Baja California Sur*: Mulege. *Baja California Norte*: Ensenada.

The genitalic structure aligns this species with *C. rossiana*. It differs in the shape of the pygophore, paler color, shorter more ovate body, slightly longer beak, more confluent punctuation and the mesosternal spot. The configuration of the paramere is somewhat variable although the basic form is typical of the *persimilis-congrua* complex. The broad piceous spot found on either side of the mesosternal carina is missing in the specimens found in Baja California Sur, Sinaloa, and Sonora. *Abronia maritima* appears to be the main host of this species although other major dune species of plant found in association with the insect in many localities are *Cakile edentula*, *Oenothera cheiranthifolia*, and *Ambrosia chamissonis*. Norland reports three generations annually in San Diego. Following is a direct quotation from Calvert E. Norland concerning his collection of this species.

"I am sending under separate cover a pentatomid I collected on July 2, 1971 at Huatabampito, just s.w. of Moroncarit or between about 40–50 miles s.w. of Navojoa, Sonora, Mexico. It was taken on *Abronia maritima* growing as a small complex on a smallish sand dune just at the edge of the little fishing village of Huatabampito. There is a series of very large unstable sand dunes leading into the village, almost entirely devoid of plant life and I was unable to locate other stands of *Abronia* in the short time I had at my disposal for collecting purposes. The small colony of *Abronia* referred to above was having a difficult time in establishing, being constantly covered over here and there with the blowing sand from the Gulf of California winds, which may help to account for the single specimen I was able to locate. I literally tore apart the entire dune on the basis that where one specimen was found, at least another should occur—but no luck.

I am sure this is the same species or one very closely related to the one you are describing."

We take a great deal of pleasure in naming this species in honor of Entomologist Calvert E. Norland and his wife, Elizabeth C. Norland. "Betty" is a botanist and, therefore, the team of Norland and Norland is quite effective.

**CHLOROCHROA ROSSIANA BUXTON AND
THOMAS, NEW NAME**
(Figures 7, 18, 25)

Cimex flavomarginatus Kouchakevitch, 1867: 99 (preoccupied; *Cimex flavomarginatus* Donovan, 1798; Hemiptera, Miridae, now *Capsodes flavomarginatus* (Don.).)

Oblong-ovate, moderately convex below, only slightly convex above. Color clear green; reflexed edge of pronotum, corium and tip of the scutellum pale whitish yellow. Three small pale spots at the base of the scutellum feeble or lacking. Tergites black except last segment and thin posterior margin of penultimate tergite green. Punctuation dense, confluent dorsally, reduced ventrally especially along the median. Head a little longer than width across the eyes; jugae slightly acuminate and slightly exceeding the tylus; antenna infuscated except segment I green; I the shortest, II the longest, III, IV, and V subequal. Rostrum slightly surpassing or equaling metacoxae, segment III and IV subequal, segment II as long as last two combined. Anterolateral pronotal margins feebly sinuate, reflexed. Embolium one-third larger than the basal width apically. Median line of scutellum often with a shallow longitudinal furrow. Hemelytral membrane colorless. Male pygophore with a well developed, labiate transverse subapical ridge. Parameres tridactylate; angle between lateral processes 90°; posterior process styliform and apically clubbed; median process an acuminate flange, anteriorly produced; anterior process styliform, angulate apically and distinctly rotated from the normal plane of the paramere. Length: 10–15 mm.

Kouchakevitch described the species from a male and a female specimen. The syntypes are in the Leningrad Museum. Dr. Kerzhner has provided us with the female syntype labeled "Calif." It agrees in all details with this distinct, coastal form.

This species lacks the callosites of *C. uhleri* and *sayi*. Similar in form to *C. granulosa*. Females may be difficult to distinguish from female *granulosa* or *ligata* although that sex of the latter is somewhat broader. The shape of the subapical transverse ridge of the male pygophore is distinctive, usually resembling the shape of a protruding human lower lip.

On the Channel Islands this bug was found in large numbers feeding on giant *Coreopsis*. *C. rossiana* is a subcoastal species and is almost entirely found within 50 miles of the ocean. Most males exhibit the "swollen" subapical transverse ridge of the male pygophore; however, in some this is reduced to a rounded ridge and hardly swollen. This is the

"greasiest" of all species studied. Most of the southern specimens were coated with a sticky, yellowish fluid which exuded after pinning.

Chlorochroa rossiana is named in honor of the former Russian Colony at Fort Ross, California.

Plants on which this species has been found include: Spectacle pod (*Dithyrea maritima*), Groundsel (*Senecio vulgaris*), Wild Rose (*Rosa* spp.), Clover (*Trifolium* spp.), Alfalfa (*Medicago sativa*), and Cocklebur (*Xanthium strumarium*).

CHLOROCHROA CONGRUA UHLER

(Figures 8, 17, 26)

Chlorochroa congrua Uhler, 1876: 288.

Pentatoma (Chlorochroa) congrua: Van Duzee, 1904: 41.

Rhytidolomia (Chlorochroa) congrua: Kirkaldy, 1909: 53.

Chlorochroa congrua: Van Duzee, 1916: 5.

Uhler's Original Description

"Broadly oval, bright grass-green; the upper surface and margins of the pleurae finely and deeply punctate between slender transverse rugae. Head having the surface impressed each side of the tylus; the lateral lobes a little longer than the tylus; exterior margins acute, elevated, more deeply sinuate than the *C. sayi*. Antennae green, but with the apical, the fourth, and the third, almost to its base blackish, and these joints particularly granulose and setose; the second joint twice as long as the third, the third much the shortest. Rostrum reaching to the posterior coxae, green; the middle line and apical joint black; basal joint a little shorter than the head; the second longer, reaching to the middle coxae; the third and fourth subequal, but much shorter. Pronotum very short and broad; the lateral margins very distinctly and evenly reflexed, and continued around the broadly-rounded humeral angles, the margin inferiorly appearing broadly tabulate and smooth. Peurae coarsely punctate, but more finely so on the elevated areas; the anterior submargin transversely linearly carinated from the anterior angle to the sternal boundary. Prosternum broadly, deeply scooped out, triangular behind; mesosternum slenderly carinate; the metasternum produced backward triangularly, and a little scooped out before the tip. Legs green, the tarsi slightly rufous. Scutellum slenderly margined and more broadly tipped with white. Corium more minutely rugulose, finely punctate, the punctures grading finer posteriorly; embolium smooth, having a few remote and obsolete punctures, and, together with the adjoining margin, white. Membrane soiled white, having 11 longitudinal nervures. Wings white, with the coarse costal nervure piceous. Tergum black as far as to the penultimate segment, very minutely and closely punctured and rugulose. Venter smooth, remotely, obsoletely punctured, but almost destitute of punctures along the middle.

"In one specimen, the lateral margin of the pronotum is white, more broadly so beneath, and the edge of the venter is deep orange. The inferior genital segment is hairy and scooped out in the form of a crescent.

"Length, 9 to 11 millimeters; width of pronotum, $5\frac{1}{2}$ to $6\frac{1}{2}$ mm. Inhabits Colorado. Collected by Lieutenant Carpenter on the foothills of Colorado in September."

Only a single female of the original type series was found in the Uhler collection (USNM). It bears four labels: Label 1—printed "COL"; Label 2—written "*Chlorochroa congrua* Col. Uhler"; Label 3—outlined and written "*Chlorochroa congrua* Col. Uhler" and rubber stamped "det Uhler"; Label 4—written "TYPE," the antenna are broken.

To the above description should be added a description of the male genitalia. The pygophore has the well developed, submarginal transverse ridge; the truncation arcuate in aspect, the margin rather tumid, shallowly excavate. Paramere tridactylate with the lateral processes at a 90° angle; the form is quite broad and the processes proportionately short; the posterior process is quite short and broad; the median process a broad flange that is moderately produced forward; the anterior process is the longest, and broadly capitate. The apex of embolium is three times broader than the base. Unlike *C. persimilis* or *C. granulosa* with which it is closely related, the anterior process of the paramere is not or only feebly rotated away from the plane of the paramere.

Carpenter's "foothills of Colorado" are somewhat confusing since our specimens are mainly found at high elevations (10,000 to 12,000 feet).

***CHLOROCHROA GRANULOSA* (UHLER)**

(Figures 9, 20, 24)

Pentatoma granulosa Uhler, 1872: 9.

Pentatoma (Chlorochroa) sayi (in part): Van Duzee, 1904: 41.

Uhler's Original Description

"General appearance of *P. juniperi* Linnaeus, bright grass-green, or pale sap-green, paler beneath, deeply, confluent, rather finely punctured transversely, minutely wrinkled on the head, pronotum, and scutellum; the surface of the latter, the hemelytra, and sometimes the pronotum, with numerous sphacelated, smooth, whitish points; the lateral margins of pronotum, the costal margin of corium to beyond the middle, and the apex of the scutellum white, rarely yellow. Rugulae of the entire under surface whitish. Head narrowed toward the tip; the tip of the lateral lobes almost acute, a little recurved, slightly longer than the tylus; the occiput bald, almost impunctured. Antennae black, stout; the tooth at base long and slender; basal joint green, very stout, hardly more than one-half as long as the second; the second longest; third a little more than two-thirds as long as the second; fourth and fifth subequal,

somewhat longer than the third. Rostrum pale green, reaching between the posterior coxae; the apical half of the end joint black or piceous; the labrum somewhat blackish. Lateral margin of pronotum a little sinuated, the edge distinctly elevated, the sub-margin depressed, and the surface broadly impressed at the outer end of the callosities. Callosities defined by sinuated, grooved, smooth lines which are bifurcated at the outer extremity. Embolium whitish, having two or three irregular series of obsolete, small punctures; membrane white or only very faintly brownish. Femore obsoletely wrinkled, the tips of tarsal joints infuscated, and the tips of nails piceous. Tergum black, excepting the penultimate and anal segments; the connexivum green. Base of scutellum sometimes with small, white spots. Length: 11 to 13 mm. Width across the humeri: 6 to 8 mm."

Uhler states "the specimens from this survey were found in Montana and near Ogden, Utah. It seems to be widely spread in the Western Territories and extends as far as California."

The female lectotype, deposited in the USNM is damaged with the head and three tarsi missing. It is nevertheless recognizable. The specimen bears four labels: Label 1—written in ink "Montana 46a"; Label 2—red printed "Type," written "682," printed USNM; Label 3—written *Pentatoma granulosa* Uhler"; Label 4—Outlined and written "*Pentatoma granulosa* Uhler," rubber stamped "Det. Uhler."

The "callosities" referred to in the above description are not to be confused with the basal callosities of the scutellum found in other species. Uhler was probably referring to the pronotal cicatrices. In addition to the characters mentioned above, should be added a description of the terminalia. The male pygophore has a well developed, bulbous, subapical transverse ridge; the truncation arcuate in aspect, emarginate, and shallowly excavated. The paramere is tridactylate with the lateral processes forming a 90° angle; the form of moderate width; the anterior process styliform and strongly angulate apically; the medial process an obtusely acuminate flange, anteriorly produced; the posterior process short, marginally parallel to tip which is either blunt, slightly enlarged or slightly curved forward.

Van Duzee (1904) confused this species with *C. sayi* because of the basal spots on the scutellum. The genitalic structure, however, aligns this form with the *persimilis-congrua* complex.

This is the most plastic of all species studied and is likely to be confused with *C. uhleri*, *C. congrua*, or *C. persimilis* within their overlapping range. Some populations have a deep horizontal crease dividing the scutellum; others have a lightly colored transverse line through the head, pronotum and scutellum or vestiges of the line on any of the dorsal surface structure. Some specimens have both crease and line, however, the usual color is light green with no crease or line.

Esselbaugh (1948, p. 30), referring to Caffrey and Barber (1919) and Patton and Mail (1935), writes about "rather glaring discrepancies" in the life history accounts of *Chlorochroa sayi* as found in Arizona and Montana. The Montana infestations of the early 1930s were probably caused by *Chlorochroa granulosa*.

CHLOROCHROA PERSIMILIS HORVATH

(Figures 10, 19, 25)

Chlorochroa persimilis Horvath, 1908: 55.

Chlorochroa uhleri (in part): Van Duzee, 1916: 5.

Ovate, moderately convex above, strongly convex below; densely, subtly punctate dorsally, less densely punctate ventrally. Vivid green with lateral margin of pronotum, connexivum and base of corium and tip of scutellum yellowish tinged with red; tergum piceous except for the last tergite in males and last two tergites in females which are entirely or partly green. Length and width of head about equal; sides of jugae sinuate, subequaling or slightly surpassing tylus. Antennal segment II distinctly the longest, often twice as long as III; III shorter than IV and V which are subequal. Rostrum slightly surpassing metacoxae; segment II as long as III and IV combined, III and IV subequal. Anterolateral margin of pronotum feebly arcuate. Embolium apically twice as wide as base. Hemelytral membrane hyaline without purple flecks. Male pygophore with a well developed, bulbous, truncated prominence; the truncation arcuate in aspect, margin carinate rather deeply excavated. Paramere tridactylate, angle between lateral processes 90°; posterior process styliform, hamulate; median process broad, an obtusely acuminate flange, strongly anteriorly produced; anterior process longest, angulately clubbed and distinctly rotated from the plane of the paramere. Length: 12 to 14 mm.

Syntypes: Hamburg, New York, and Canada (National Museum of Hungary), Saratoga, New York (American Museum of Natural History). (Not examined.)

The name *persimilis* is derived from the superficial resemblance of this species with the European *Pitedia juniperina* Linnaeus. References by Sayi and Uhler to this latter species were probably misapplied to the American form. In structure *C. persimilis* is closely related to *C. granulosa* which is western in distribution. Problems may arise in distinguishing individual specimens because *C. granulosa* is a plastic form for which no single character is reliably diagnostic. *C. persimilis*, on the other hand, is quite consistent in its form; hence, it can be accurately distinguished provided several key characters are examined. *C. persimilis* is slightly larger and distinctly more ovate. Coloration is always darker green than *granulosa* and the marginal vitta on the pronotum and the tip of the scutellum are characteristically distinct. Additionally, the abdominal dorsum is always dark excepting the last segment(s), while in *C. granulosa* the abdominal dorsum is usually green. The male pygophore has a more pronounced submarginal prominence, and the posterior process of the paramere is always styliform and hooked forward. In *C. granulosa* the posterior process is normally straight and stout or capitate, but in some specimens the process is curved forward.

Plants on which this species has been found include: *Amsonia* spp. in Florida and Missouri, Esselbaugh (1948) reported it on prickly pear,

Opuntia refinesquei. Blatchley (1926) reports this insect under the name *Chlorochroa uhleri* on juniper, willows, and bunch grass in sandy places.

CHLOROCHROA KANEI BUXTON AND THOMAS, N.SP.
(Figures 11, 16, 26)

Elongate, oval; body form similar to *C. sayi*, moderately convex above and below. Hemelytra and scutellum densely punctate, pronotum and venter less densely punctate. Color dark violaceous green with connexivum, tip of scutellum, base of costa and reflexed edge of thorax including a broad marginal band, pale stramineous; venter paler; antenna black. Head slightly longer than width across the eyes; jugae and tylus subequal; antennal segment I shortest, II slightly the longest, III, IV, and V subequal; rostrum attaining posterior edge of metacoxae; segment II almost as long as III and IV combined, which are subequal. Anterolateral thoracic margin strongly reflexed and feebly sinuate. Embolium widened apically, three times the basal width. Tergum piceous. Hemelytral membrane with minute purple flecks especially along the veins. Male pygophore with well developed bulbous, submarginal transverse ridge; the truncation broadly arcuate, similar in aspect to *C. rossiana* though not tumidly labiate, more carinate, more deeply excavated. Paramere tridactylate; angle between lateral processes approximately 90°; anterior process styliform, apically angulate; median process an obtusely acuminate flange, anteriorly produced; posterior process subterete or feebly clubbed. Length: 12 to 15 mm.

Holotype: Male, California, Mono County, Tom's Place, E. A. Kane, collector, October 7, 1971. Deposited U.S.N.M. #76127.

Paratypes: Two male, three female, same data as holotype; one male, two female, California, Mono County, Independence, J. E. Fitch, collector, April 13, 1941; one male, California, Mono County, Sherwin Pass, W. Turner, collector, September 1, 1963; one male, California, Mono County, Grant Lake, J. A. Chemsak, collector, September 10, 1956. Deposited U.S.N.M., California Academy of Sciences, and collection of authors. Seventy-one additional paratypes were examined from the California counties of Alpine, Inyo, Kern, Lassen, Modoc, Mono, Nevada, Shasta, Siskiyou, and Tuolumne. We have seen specimens from Ormsby County, Nevada.

Closely related to *C. rossiana*; differs in being slightly larger, darker in color with more distinct markings and more convex dorsally. The paramere with processes shorter and more simply structured. The pygophore is not tumescent although quite similar in aspect to *rossiana*.

Superficially, *C. kanei* resembles *C. ligata*, however, the pygophore is entire and not depressed. Female specimens will be difficult to distinguish from *C. ligata* since *C. kanei* is found with or without the purple-flecked wing membrane.

We take pleasure in naming this insect after the late Edward A. Kane, a gifted survey entomologist formerly employed by the California Department of Food and Agriculture. Following is the exact copy of Mr. Kane's field notes of October 7, 1971:

"Two collections of *Chlorochroa* were made. The first was $\frac{1}{4}$ mile S.E. of Tom's Place, Mono Co. (T45, R30E) and the second $1\frac{1}{2}$ mi. N.W. of the Convict Lake turnoff from 395 in Mono Co. (T45, R29E, Section 4-NE $\frac{1}{4}$). Both collections were taken from *Chrysothamnus nauseosus* along Highway 395 at elevations of 6,900 ft. to 7,100 ft.

"Climatic conditions were sunny, approximately 70° and the time was between 1:00 and 3:00 p.m. The wind was blowing intermittently not exceeding 10 M.P.H. All specimens had at least $\frac{1}{2}$ of the anterior end of their body directed into the 'floral clusters.' Whether this was due to feeding or a response to the wind was undetermined. The seed ovaries were soft."

Plants on which this species has been found include rabbit brush (*Chrysothamnus* spp.) and mountain alder (*Alnus tenuifolia*). Some specimens bear host labels for *Ceanothus* and *Pinus*.

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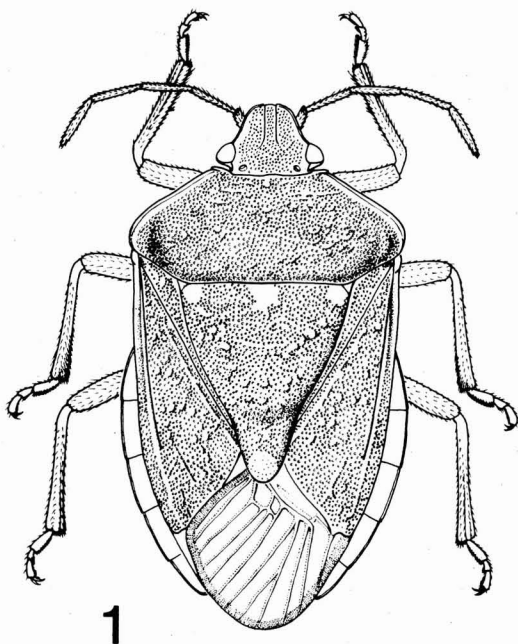


Figure 1. Habitus *Chlorochroa sayi* (Stal).

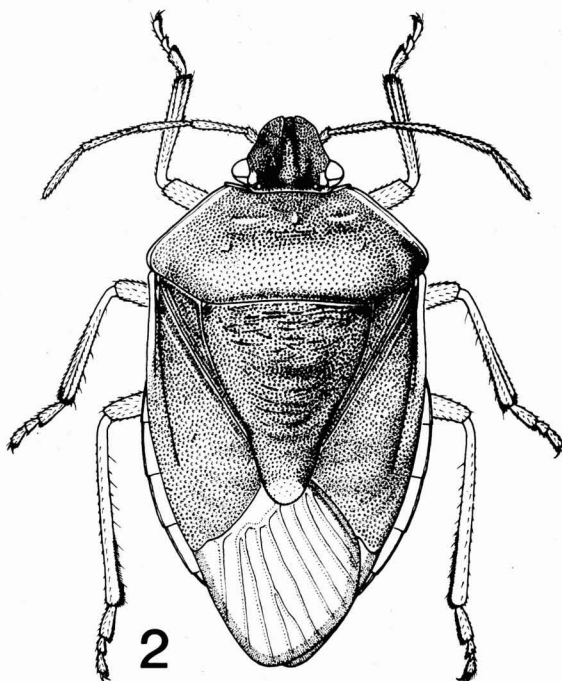
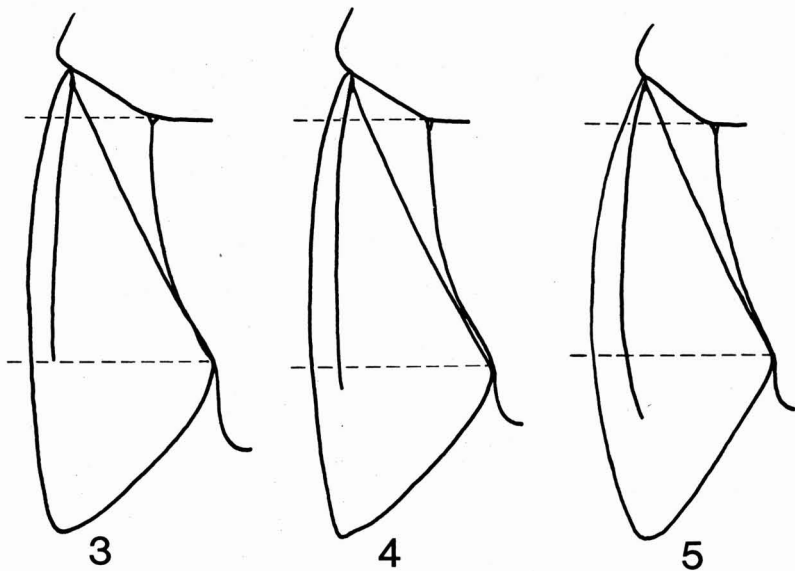
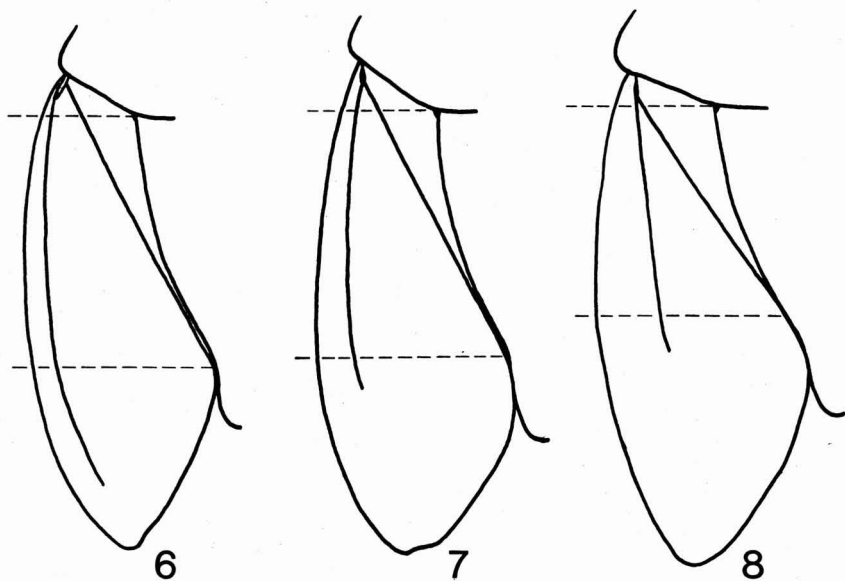


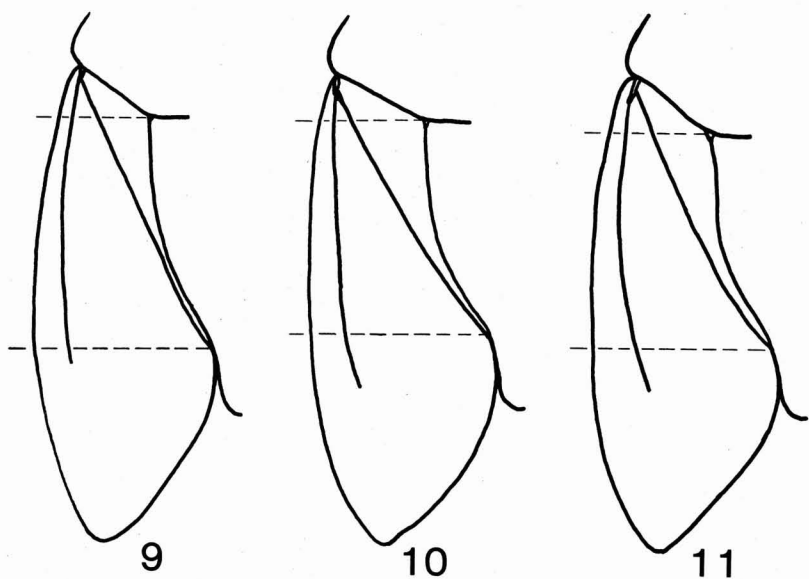
Figure 2. Habitus *Chlorochroa ligata* (Say).



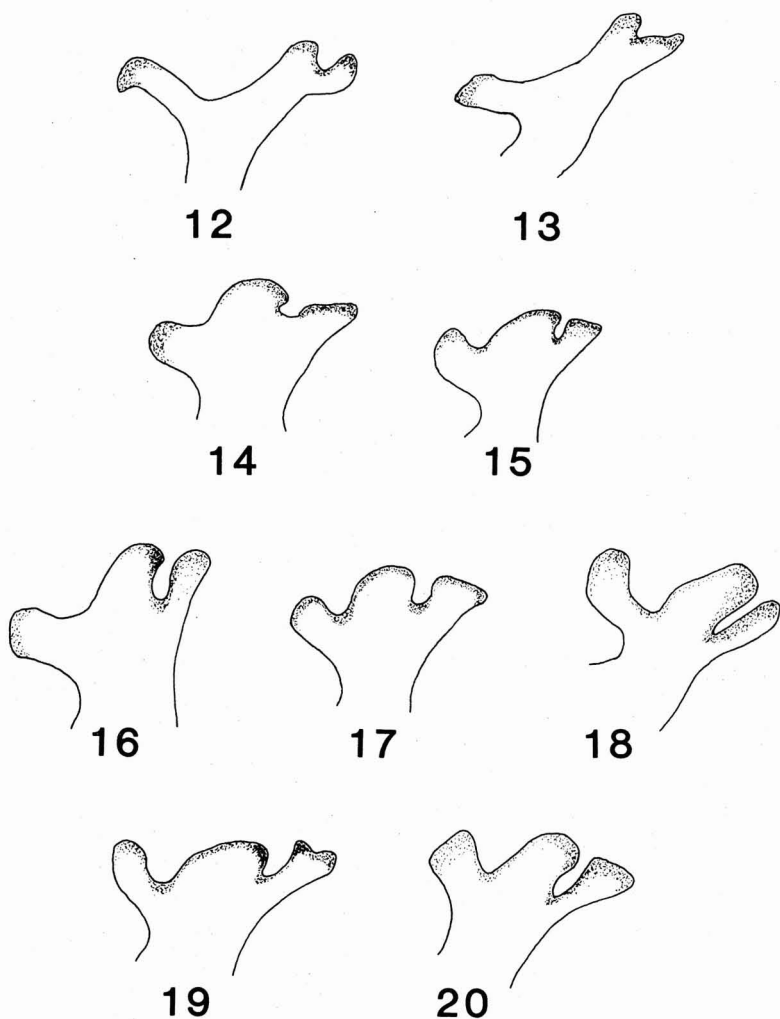
Figures 3-5. Hemelytra *Chlorochroa* spp.: 3) *C. sayi* (Stal); 4) *C. uhleri* (Stal); and 5) *C. ligata* (Say).



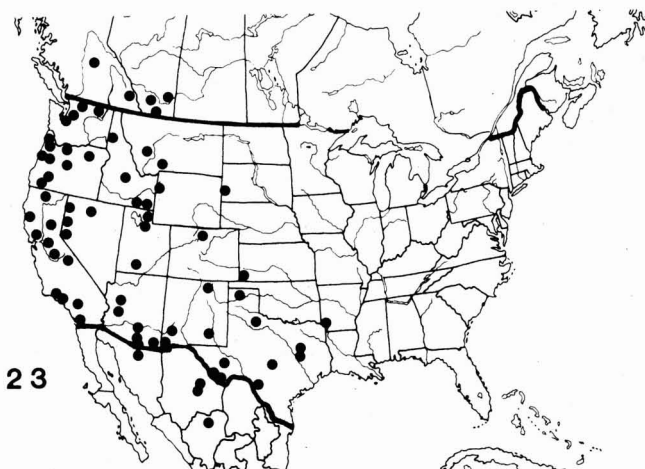
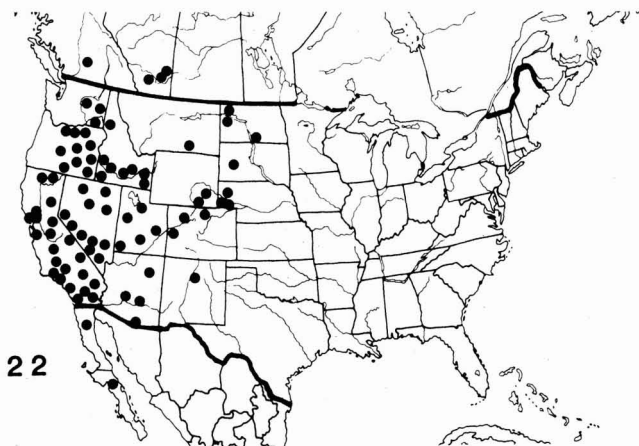
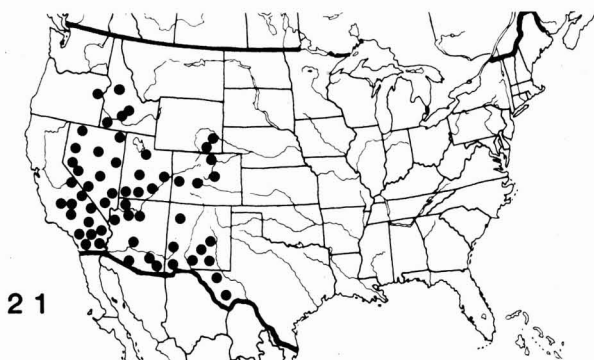
Figures 6-8. Hemelytra *Chlorochroa* spp.: 6) *C. norlandorum* Buxton and Thomas; 7) *C. rossiana* Buxton and Thomas; 8) *C. congrua* Uhler.



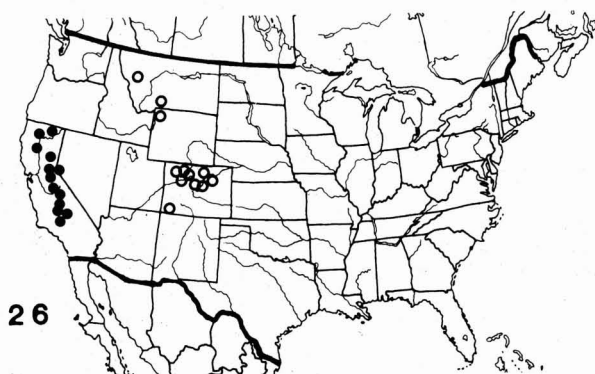
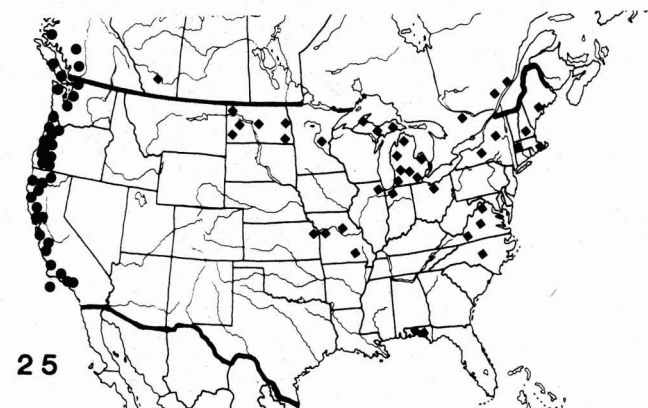
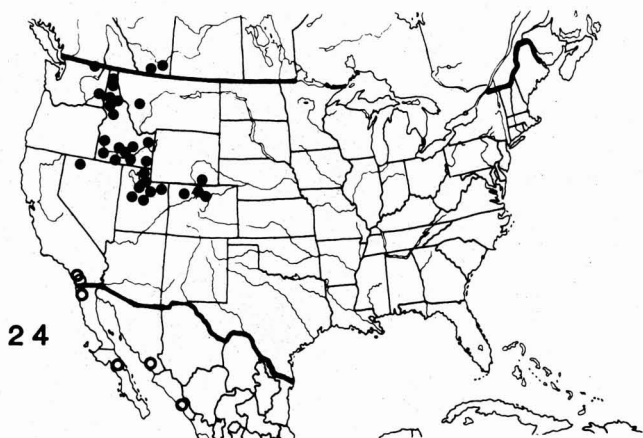
Figures 9-11. Hemelytra *Chlorochroa* spp.: 9) *C. granulosa* (Uhler); 10) *C. persimilis* Horvath and 11) *C. kanei* Buxton and Thomas.



Figures 12–20. Male parameres of *Chlorochroa* spp.: 12) *C. sayi* (Stal); 13) *C. uhleri* (Stal); 14) *C. ligata* (Say); 15) *C. norlandorum* Buxton and Thomas; 16) *C. kanei* Buxton and Thomas; 17) *C. congrua* Uhler; 18) *C. rossiana* Buxton and Thomas; 19) *C. persimilis* Horvath and 20) *C. granulosa* (Uhler).



Figures 21–23. Known geographic distribution of *Chlorochroa* spp.:
 21) *C. sayi* (Stal); 22) *C. uhleri* (Stal) and 23) *C. ligata* (Say).



Figures 24–26. Known geographic distribution of *Chlorochroa* spp.: 24) *C. granulosa* (Uhler) (●) and *C. norlandorum* Buxton and Thomas (○); 25) *C. rossiana* Buxton and Thomas (●) and *C. persimilis* Horvath (■); 26) *C. kanei* Buxton and Thomas (●) and *C. congrua* Uhler (○).

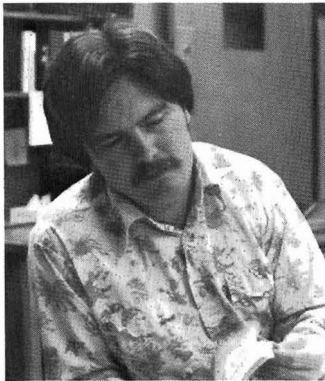


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At present Don is working on his doctoral dissertation: Cytogenetics and Evolution in the Pentatomid genus Banasa.